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Original Research Article

Comparison of efficacy of chlorhexidine alcohol scrub and povidone iodine scrub in hand cleansing in elective clean surgery

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ABSTRACT

Background: Hand asepsis is the best prevention for surgical site infection (SSI). The surgeon uses different methods of surgical hand antisepsis. The present study was undertaken to compare and evaluate the efficacy of chlorhexidine alcohol versus povidone iodine in elective clean surgeries for prevention of SSI.
Methods: We conducted a double blind, prospective, interventional study on patients undergoing elective clean surgeries in general surgical operation theatre of a tertiary care center. Surgeons were assigned randomly to use povidone-iodine 7.5% surgical scrub or chlorhexidine gluconate 2.5% prior to surgery. The number of patients who developed a surgical site infection was expressed as a percentage of the total. Incidence of surgical site infection was calculated individually in both the groups.
Results: Both the groups were comparable in terms of various variables. Infection rates of both the groups were similar with respect to age, gender, duration of surgery, personal history of addictions. However, in case of comparison BMI in both groups in patients who had infection and it was observed that BMI was significantly different in both groups. In normal and overweight patients chlorhexidine group had more infection while moderately obese patient's povidone-iodine group had more infection.
Conclusions: Povidone-iodine 7.5% surgical scrub and chlorhexidine gluconate both are equally good scrubs in elective clean surgeries.

Keywords: Surgical site infection, Hand asepsis, Povidone-iodine, Chlorhexidine gluconate

INTRODUCTION

Surgical site infections (SSIs), which occur in up to 30% of all surgical procedures, are associated with significant morbidity and mortality, including increased length of hospitalization and increases of 2-fold to 5-fold in hospital costs.[1-4] It is an established fact that the normal skin of healthy human beings harbours a rich bacterial flora. Normally considered non-pathogenic, these organisms may be a potential source of infection of the surgical wound, making skin preparation at the time of the procedure critical. Hand antisepsis remains the overall best preventive solution to eliminate transient micro-organisms and reduce resident skin flora and therefore surgical site infection. The surgeon uses different methods of surgical hand antisepsis with the aim of reducing surgical site infections caused by recent days multidrug resistant microorganisms. With most other antiseptics having failed to prove in eradicating these microorganisms, povidone iodine is promising for good surgical antisepsis (hand preparation). The availability of newer alcohol based chlorhexidine scrubs led to testing the efficacy of these in comparison to the traditional povidone iodine scrubs.[5]

The present study was undertaken to compare and evaluate the efficacy of chlorhexidine alcohol versus povidone iodine in elective clean surgeries for prevention of SSI.

METHODS

Patients admitted in a tertiary care center were the source of data. Patients undergoing for clean surgeries (elective, primarily closed, no break in aseptic technique; respiratory, gastrointestinal, biliary and genitourinary tracts not entered) were included in the study. All patients were given a single dose of ceftizoxime sodium 1 g immediately on induction of anesthesia. Pregnant females, patients less than 12 years of age, immuno-compromised patients and those who were allergic to above antibiotic were excluded from the study. We conducted a double blind, prospective, interventional study on patients of tertiary care center from elective general surgical operation theatre after obtaining approval from the ethical committee and written informed consent from the patients. The number of patients who developed a surgical site infection was expressed as a percentage of the total. Incidence of surgical site infection was calculated individually in the povidone - iodine 7.5 % surgical scrub (A) group (n=191) and Alcohol 70%+chlorhexidine gluconate 2.5% (B) group (n=208). The study participants underwent the hand preparation protocol of 5 minutes of scrubbing with 10ml of either of these where rinsing time was not included in the total scrub time. Surgeons were assigned randomly to use scrubs A or B prior to surgery. Each case was assessed with respect to age, sex, diagnosis, wound related co-morbidities like diabetes, immunosuppressive disorders. Every patient was kept in ward for first 3 days post-surgery then discharged unless complaints of fever, pain at local site, or soakage of dressing where wound check was done daily until the wound healed or up to a maximum of 30 days whichever was earlier otherwise first wound check was done at the time suture removal and wound if healed suture removal was done and end of follow up, the wounds graded 1 to 5 based on SOUTHAMPTON wound scoring system in the post-operative period.

RESULTS

Both the groups were comparable for different variables like age, gender, personal history of addiction such as tobacco chewing, smoking, alcohol. Differences for duration of surgery and body mass index (BMI) of patients were also not statistically significant.

In group A, of the 191 total 18 got infected, of 131 men 10 and of 60 women 8 got infected. No statistically significant relationship with increasing trends of age was found out. None of the smoker, alcoholic or tobacco chewer was infected, short duration group appeared to be infected more but since total in that duration group were more so the ratios seemed to be maintained, so statistically insignificant. No statistically significant relationship with infection and increasing trends of BMI was found out. Only 2 in the povidone group presented with elevated counts.

In group B, of the 208 total 20 got infected, of 149 men 14 and of 59 women 6 got infected. One of 6 tobacco chewers and 2 of 10 smoker and alcoholic got infected-not statistically significant. Short duration group appeared to be infected more but since total in that duration group were more so the ratios seemed to be maintained, so statistically insignificant. No statistically significant relationship with infection and increasing trends of BMI was found out. None of the infected presented with raised counts.

Table 1: Age group.

	Group		Total
Age group	**Povidine Iodine**	**Chlorhexidine**	
10-15	2	4	6
16-20	2	0	2
21-25	3	1	4
26-30	0	2	2
31-35	1	3	4
36-40	2	3	5
41-45	1	1	2
46-50	1	2	3
51-55	3	2	5
56-60	2	1	3
61-65	1	0	1
66-70	0	1	1
Total	18	20	38

Chi-Square Tests: Pearson Chi-Square;
Value: 9.655(a), df: 11, Asymp. Sig. (2-sided): 0.562

Table 2: Gender group.

Gender	Group		Total
	Povidine Iodine	**Chlorhexidine**	
Male	10	14	24
Female	8	6	14
Total	18	20	38

Chi-Square Tests: Pearson Chi-Square;
Value: 0.849(b), df: 1, Asymp. Sig. (2-sided): 0.357

Table 3: Duration of surgery.

	Group		Total
Duration group	**Povidine Iodine**	**Chlorhexidine**	
0-30	9	15	24
31-60	6	2	8
61-120	3	3	6
Total	18	20	38

Chi-Square Tests: Pearson Chi-Square;
Value: 3.404(a), df: 2, Asymp. Sig. (2-sided): 0.182

Table 4: BMI of patients.

	Group		Total
BMI group	Povidine Iodine	Chlorhexidine	
<18.5	1	0	1
18.6-25	7	11	18
25-30	5	9	14
35-40	5	0	5
Total	18	20	38

Chi-Square Tests: Pearson Chi-Square;
Value: 7.949(a), df: 3, Asymp. Sig. (2-sided): 0.047

The presentation of infection in both the groups was same, most of them presented with local pain and erythema. Both of them presented with similar spectrum of grades.

Table 5: Infection rate.

Group	Infection		Total
	Yes	No	Yes
Povidine Iodine	18	173	191
Chlorhexidine	20	188	208
Total	38	361	399

Chi-Square Tests: Pearson Chi-Square;
Value: 0.004(b), df: 1, Asymp. Sig. (2-sided): 0.948

Table 6: Southampton grade.

Group	1A	1B	1C	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	5	Total
Povidine Iodine	0	0	10	0	0	3	2	0	0	1	1	0	1	0	18
Chlorhexidine	0	0	10	0	0	1	8	0	0	1	0	0	0	0	20
Total	0	0	20	0	0	4	10	0	0	2	1	0	1	0	38

Chi-Square Tests: Pearson Chi-Square;
Value: 6.513(a), df: 5, Asymp. Sig. (2-sided): 0. 259

So in both groups neither age, personal history, gender, duration of surgery, BMI had statistically significant impact on the infection rates.

It was possible to compare between the two groups as the baseline population in both group was comparable or similar. So, when we evaluated if there was any difference in the impact of age, gender, personal history, and duration of surgery on infection in both groups in patients who had infection, it was observed in both groups there was not much difference. However, in case of comparison BMI in both groups in patients who had infection and it was observed that BMI was significantly different in both groups. In normal and overweight patients chlorhexidine group had more infection while moderately obese patient's povidone Iodine group had more infection. We need more detailed studies to confirm this.

DISCUSSION

Povidone-Iodine is been used for preoperative skin preparation in surgeries since 1955 and is preferred universally. But even then a surgical site infection is a major complication it fails to control completely. Chlorhexidene has been widely used as oral antiseptic solution in mouthwashes. Chlorhexidene-Alcohol with its increased efficacy has been recently made available all over as an antiseptic and disinfectant.[6] We compared the efficacy of chlorhexidine alcohol and povidone iodine in elective clean surgeries for prevention of SSI.

Povidone-iodine exerts its antiseptic properties in two ways, first it substitutes the covalently bound hydrogen groups such as -OH, -NH, -SH, or CH groups. Second povidone is an iodophor and it reacts with the oxygen containing functional groups. Free iodine determines the bactericidal activity; total iodine determines the ability to kill bacteria. Iodine solutions have rapid, broad-spectrum antimicrobial activity against bacteria, viruses, and fungi. It quickly penetrates micro-organisms and attacks neucleotides, fatty acids and thiol groups. It inhibits protein synthesis by oxidizing the thiol group.[7] Chlorhexidene is a cationic biguanide that binds to the negatively charged surface of bacterial cell wall leading to alteration in permeability, which leads to leakage of cytoplasmic contents and finally cell death.[8]

The literature on efficacy of these agents is conflicting. Some studies found alcohol based chlorhexidene to be superior to povidone-iodine 10% for cutaneous antisepsis.[9-11] Mimoz et al assigned patients to skin preparation with 0.5% chlorhexidene in alcohol or povidone-iodine in an aqueous solution.[10] The contamination rates were much lower in the chlorhexidene group ([1.4% vs. 3.3%]; odds ratio, 0.40 [95% CI, 0.21-0.75]; P=0.004). In patients undergoing clean-contaminated surgery skin preparation with chlorhexidine led to lower incidence of surgical site infections (9.5% vs. 16.1%; P=0.004) compared to that with povidone-iodine.[9] Similarly, in-patients undergoing amniocentesis 2% chlorhexidine reduced the colony count more than the povidone iodine solution.[11]

In contrast, several studies suggest that both agents are equally effective. A prospective study observed the impact of povidone-iodine on residual bacteria and

development of post-operative surgical site infections.[12] Of the 1014 swabs taken, 3.6% showed positive cultures and this had no correlation with the development of post-operative surgical site infection (4.04%). Langgartner et al found that sequential application of chlorhexidine 0.5% in alcohol followed by povidone-iodine was better than either agents used alone.[13] The catheter tip bacterial colonization rate was 4.7% with the combination as compared to 30.8% (povidone-iodine 10%) and 24.4% (chlorhexidine). For cutaneous antisepsis in patients undergoing hernia surgery, both chlorhexidine in alcohol and povidone iodine led to similar reductions in skin bacterial colony counts and the infection rates were similar (9.5% vs. 7.0%, p=0.364).[14] Girard et al evaluated the effect of povidone-iodine (1 year) and chlorhexidine over the next year for CVC related infections.[15] They found significant reduction in colonization with chlorhexidine (1.12 vs. 1.55; p=0.041), however, the reduction in CVC related infections and bacteraemia was non-significant. Another study [16] showed no difference between the two and concluded that chlorhexidine 0.5% was 'as effective as' povidone-iodine 10%.

Two meta-analyses have shown the superiority of chlorhexidine over povidone iodine in vascular catheter site care and pre-operative abdominal wall antisepsis in patients undergoing clean contaminated abdominal surgery.[17,18]

In our study, in povidone group, of the 191 total, 18 got infected; of 131 men 10 and of 60 women 8 got infected. No statistically significant relationship with increasing trends of age was found out, none of the smoker, alcoholic or tobacco chewer was infected, short duration group appeared to be infected more but since total in that duration group were more so the ratios seemed to be maintained, so statistically insignificant. No statistically significant relationship with infection and increasing trends of BMI was found out. Only 2 in the povidone group presented with elevated counts.

In chlorhexidine group, of the 208 total, 20 got infected; of 149 men, 14 and of 59 women, 6 got infected. One of 6 tobacco chewers and 2 of 10 smoker and alcoholic got infected- not statistically significant, short duration group appeared to be infected more but since total in that duration group were more so the ratios seemed to be maintained, so statistically insignificant.

No statistically significant relationship with infection and increasing trends of BMI was found out. None of the infected presented with raised counts.

So in both groups neither age, personal history, sex, duration of surgery, BMI had statistically significant impact on the infection rates. It was possible to compare between the two groups as the baseline population in both group was comparable or similar. So, when we evaluated if there was any difference in the impact of age, sex, personal history, and duration of surgery on infection in both groups in patients who had infection, it was observed in both groups there was not much difference. However, in case of comparison BMI in both groups in patients who had infection and it was observed that BMI was significantly different in both groups. In normal and overweight patients Chlorhexidine group had more infection while moderately obese patients povidone Iodine group had more infection. We need more detailed studies to confirm this.

Finally, we found out that both the groups i.e. povidone - iodine 7.5 % surgical scrub (A) and Alcohol 70%+chlorhexidene gluconate 2.5% (B), were comparable to each other. We did not find any superiority of one group over other.

Literature says that when time is of essence, chlorhexidine may be preferred to povidone-iodine as contact time/duration is much shorter with Chlorhexidine. However, in our study, the infection controlled by both groups with respect to duration/contact time was comparable. As we know through literature, old age and obese patients are more prone to infection, but in our study we didn't find any such relation. However, in case of comparison BMI in both groups in patients who had infection and it was observed that BMI was significantly different in both groups. In normal and overweight patients chlorhexidine group had more infection while moderately obese patients' povidone Iodine group had more infection. We need more detailed studies to confirm this.

Cost is a consideration when choosing an antiseptic, however, we did not study the cost effective analysis for both groups. Both antiseptic solutions can lead to allergic reactions, particularly cutaneous hypersensitivity. We did not observe any hypersensitivity reactions in either group.

The strength of our study was its design as there are very few studies, which are randomized, controlled, double blind and prospective, in comparing the efficacy of povidone iodine and chlorhexidine. The limitations of our study include convenient sample size and lack of diversity in patients, as it is a single center study.

Future studies need to explore the comparative efficacy of these agents in larger number of patients with clinically relevant end-points. In the summary, we found that there is no difference between povidone-iodine aqueous solutions, in terms of efficacy.

CONCLUSION

We found out that both the groups i.e. povidone - iodine 7.5% surgical scrub and Alcohol 70%+chlorhexidene gluconate 2.5% were comparable to each other. We did not find any superiority of one group over other. In both groups neither age, personal history, sex, duration of surgery, BMI had statistically significant impact on the infection rates. We evaluated age, sex, personal history,

and duration/contact time in both groups in patients who had infection and it was observed that all were comparable. However, in case of comparison BMI in both groups in patients who had infection and it was observed that BMI was significantly different in both groups. In normal and overweight patients' chlorhexidine group had more infection while moderate obese patients' povidone Iodine group had more infection but the limitations were convenient sample size and lack of diversity in patients, as it is a single center study. Future studies are needed to confirm the same. We did not observe any hypersensitivity reactions in either group. So, both are equally good scrubs in elective clean surgeries.

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